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# PLANNING CONSIDERATIONS FOR WINTER SPORTS RESORT DEVELOPMENT



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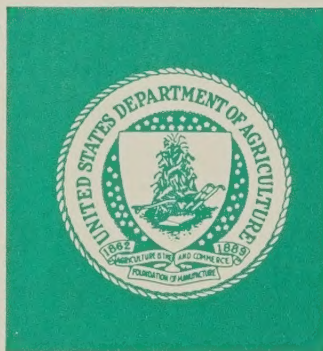




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DEVELOPMENT PLANNING—WINTER SPORTS RESORTS

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## PREFACE

By 1970, skiing was a sport of major importance on the National Forests and had begun to mold the growth and economy of many rural areas. Large segments of private lands were being developed without the benefit of city or county planning. The winter sports resort industry had matured and many operations were being conducted in a businesslike manner. The impacts of development were far broader than the resorts themselves. Entirely new communities have been established and existing ones revitalized or expanded. Year-long employment and greater stability had occurred. The amount of lift capacity is expected to more than double in the 1970's. Many additional communities are expected to develop as all-seasons resorts.

Determining the location of these new resorts and communities involves the coordinated effort of the Forest Service, local government, industry and the general public. Land suitable and available for development of winter resorts is limited and optimum use must be made of the space that is available. Resorts need good transportation and utility services which affect land far removed from the resort itself. The need for long range planning is paramount.

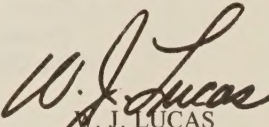
Basic land use decisions must be made by the Forest Service before development is authorized. Environmental analyses, involving thorough study of multiple use alternatives, environmental alternative actions and public involvement are required by law.

This publication deals with broad policies involving resort development on the National Forests and adjacent lands; it discusses details which must be considered in development plans submitted to the Forest Service for approval. Plans

must be dynamic, leaving opportunities for alternative actions. This is necessary since technology, social-economic system and public needs are constantly changing. It deals primarily with planning the mountain rather than the community. The principles of community design involve a separate but equally important specialization. Application of the principles discussed here will vary widely from one area to another. Plans submitted to the Forest Service should show the relationship of the development to both public and private lands. An area of land for public recreation is being planned. Conceptual design is needed for the planning area before development commitments are made. Detailed location and construction plans should follow as individual projects are readied for development.

The National Forests are, and will continue to be, an essential element in winter resort area growth. While the proponents are responsible for preparation of plans, cooperation and coordination with the Forest Service throughout the planning process is essential. Publications and technical information of a wide variety are available from the Forest Service. Consultants and specialists are also available to assist planners.

This is an important industry and one which has a long term effect on public lands and community development. I call on each of you involved in resort area planning and management to improve the planning process and the compatibility of uses of our forest lands.



W. J. LUCAS  
Regional Forester



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## PROCESS OF APPROVING SITES FOR DEVELOPMENT AS WINTER RESORT AREAS

It is Forest Service policy to provide for the development of winter resort sites to meet public needs, where they are compatible with other resource values. Determining needs and compatibility is complex and may be a time consuming process.

The Multiple Use—Sustained Yield Act of 1960 authorizes and directs the Forest Service to manage the National Forests under principles of multiple use and to produce a sustained yield of products and services, and for other purposes. The National Environmental Policy Act of 1969 directs the Forest Service to utilize a systematic, interdisciplinary approach to planning; to give environmental amenities and values appropriate consideration; to consider alternative courses; to involve the public and appropriate agencies; and to perform other procedures.

A proponent may apply for a permit to develop a resort area before the Forest Service has completed the land use studies necessary to designate an area for this, or another type of long term land use. If the proponent wishes to move ahead

rapidly, he will be expected to collect and provide to the Forest Service much of the ecological, social, technical and other data necessary for the preparation of the required environmental analyses or statements. Data collected by specialists, for the proponent, must be in a form which can be analyzed, supplemented, or used by the Forest Service. Sites will not be approved for a specific use until reports have been approved by the Regional Forester, or when appropriate, a higher authority.

Environmental analyses not only consider the various uses for which the land is suited, but also consider the feasibility of a site for a particular purpose. There are numerous sites that are physically feasible for winter resort development, but may not be acceptable for this purpose because of conflicting social, resource or other reasons. To determine the technical feasibility, extensive studies of terrain, weather, snow conditions, soil, hydrology, access, economics, construction methods, environmental impact and other factors must be conducted.

*Aspen, Colorado, provides a preview of the future. Many communities now dependent upon mining or agricultural economies will experience rapid growth and change because of recreation resort development. Where mining activity is declining, resort development may stabilize the economy. These communities will develop many social, medical and business amenities which they now lack.*





## FEASIBILITY STUDIES, LAND USE PERMITS AND DEVELOPMENT PLANS

### DEVELOPMENT OF AREAS IN CONJUNCTION WITH PRIVATE LAND

Proponents of a new area or expansion of an existing one will be responsible for preparation of feasibility reports. The Forest Service will make sufficient independent studies to verify data reported by a proponent and will determine what optimum level of development will be required to fulfill the long-term public needs. Where the National Forest land can be developed from different private land ownerships, competition through prospectus may still be required, regardless of who made the studies.

### DEVELOPMENT OF AREAS ENTIRELY ON NATIONAL FOREST LAND

The Forest Service prepares feasibility studies preparatory to issuing a prospectus seeking development by a private party. The prospectus will state the minimum services to be provided and will normally include a sample permit showing other operating requirements. The bidders will be required to prepare a development proposal and show financial and managerial capabilities. The successful bidder will be issued a development permit, but might be required to refine his plan in order to overcome any shortcomings before proceeding with detailed construction plans.

### MAKING STUDIES ON NATIONAL FORESTS

Individuals or groups may perform studies on National Forest lands without a permit. However, when equipment or facilities must be installed, permits will be required for those improvements. This procedure allows more than one proponent, as well as interested members of the public, to

study an area concurrently. When equipment or facilities of a temporary nature must be installed, permits will be required for those improvements. The cutting of trees, or other changes in the forest condition, also require a permit. To avoid any misinterpretation by the public, permits will not be issued solely for the purpose of making ski area feasibility studies. PERMISSION GRANTED TO COLLECT DATA AND MAKE STUDIES DOES NOT GUARANTEE THAT A DEVELOPMENT PERMIT WILL EVENTUALLY BE ISSUED, EVEN IF AN AREA PROVES TO BE TECHNICALLY AND ECONOMICALLY FEASIBLE.

### THE DEVELOPMENT AND OPERATING PERMIT

The successful proponent is issued a Term Special Use Permit. This is the contract and operating agreement between the Forest Service and the proponent. This permit covers an area up to 80 acres, usually where the major capital investments are located. It is issued for a period up to 30 years. A companion Special Use Permit would be issued for the additional area needed for the development of ski runs and other improvements. The Forest Service may not terminate Term Special Use Permits, except upon breach of the permit terms by the permittee, without due compensation. The permits may be renegotiated during this term to provide for additional development, or to update the permit provisions, if agreeable to both parties. When an added commitment is made to provide improved or additional services and capital investments, the term of the permit may be extended to cover a maximum of 30 years. Normally, when permits are issued for new development resorts, a period of about two years is allowed for the completion of development plans, financial arrangements and other matters. If these requirements cannot be completed, the permits might be subject to termination.



## **POLICY REGARDING DEVELOPMENT PLANS**

Development plans for all new or enlarging resort developments must be approved by the Regional Forester before construction may begin. Plans must show the development concept for the entire area under consideration. They should represent the best thinking available at the time they were made. Situations change and development plans should change accordingly. When significant changes are made, reapproval of the plan by the Regional Forester is required.

The winter resort industry has been the catalyst for the accelerated growth of resort communities during the past decade. Development plans can no longer be limited to such items as skiing facilities, lodges and runs. While the winter sports developments may constitute the initial phase of development, an all-seasons resort and community complex must be anticipated. Land suitable for these purposes is limited and, therefore, the optimum development of each site must be planned initially.

The team, or interdisciplinary approach to planning is required. Specialists in ecology, skiing, soil, hydrology, business and accounting, engineering, community planning, architecture, landscape management, forestry and other appropriate disciplines should be involved, and their team efforts directed by capable management. This approach has proven to be the key to preparation of well coordinated and effective plans which can be accepted by the public. ELEMENTS OF LONG RANGE PLANNING ARE NOT GENERALLY UNDERSTOOD BY MOST PEOPLE AND ORGANIZATIONS. AN EXTRA EFFORT MUST BE MADE BY PLANNING PROJECT MANAGERS.

## SEPARATE SKI AREAS VS. EXPANSION OF EXISTING ONES

Under certain circumstances, established ski areas can be expanded substantially beyond that authorized by the original permit. In other cases, adjacent areas may have to be developed as separate areas. In all cases, new Special Use Permits, or amendments to existing ones, will be required.

Expansion of an existing area may be permitted when:

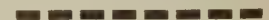
1. It is not feasible to develop an expansion area separately.
2. It is feasible to develop a separate and viable area, but the original permittee controls all of the key base property.
3. The two areas will be connected by a series of lifts and ski trails in a manner which enables them to be operated as a unit.
4. The landownership pattern is such that optimum development of the expansion area can be achieved.
5. The Forest Service has agreed that expansion is timely and in the public interest.

A separate permit, or advertisement of a prospectus, will be required when:

1. It is feasible to develop the area separately.
2. There is a competitive demand by other persons to develop the area. Sometimes this can only be determined by the advertising of a prospectus.
3. The controlling key base lands and ski slopes are controlled by a public agency or agencies, or by more than one private landowner.
4. It may not be logical to tie two adjacent areas together.
5. The developer wishes to have a separate area under a new permit, but does not wish to have the permit for the existing area changed.

*At Breckenridge, Colorado, expansion of the existing area was permitted because the two areas tied together, and could be interconnected; the permittee agreed to provide the required public facilities and services; landowners controlling both base properties agreed to work together and to provide permanent skiing and parking easements on the private land; and the existing community will benefit.*

*Proposed and existing chairlifts.*





SKIED RIGHT OF WAY

PUBLIC PARKING



## LAND USE PLANNING

### DETERMINE THE AREA SATURATION THRESHOLD

The number of people that should be accommodated varies widely because of topography, snowfall, esthetics, limitations of either the base or the mountain and many other factors. Whatever the optimum number might be, space must be reserved at the base to provide parking and the service facilities which ultimately will be needed.

The acreage suitable for base facilities varies widely among areas. To a great degree, it determines if an area can be developed to community proportions or if the area's success is dependent upon people within commuting distance. The Forest Service recognizes the expense of developing a resort area and that land sales or leases are often needed to recover initial development costs within a reasonable period of time. There must be a balance between the development opportunities on the mountain and at the base area.

Photographs used here show many run designs and patterns. Reasons vary. Skiing quality is a major factor since skiers do not like crowding or congestion, poor snow conditions or poorly designed trails. If the skiing difficulty of a trail changes, it will hinder skiers who cannot easily negotiate the most difficult sections. It may be necessary for run location to be manipulated in order to create an ideal proportion of beginner, intermediate and advanced or expert trails. To do so may lower the capacity of an area, but increase its popularity and viability.

Heavy skier use can wear out snow, particularly in congested areas. Snowmaking, dispersing of skiers and other means can be used to increase the capacity of an area. Wind, unstable soil conditions, uncontrolled flowing water, esthetic considerations and other factors can reduce the capacity if these factors are not considered initially.

Determining the optimum capacity involves many technical, economic and social disciplines. It is both a subjective and physical matter. It is time consuming and expensive to determine, but an essential element in area planning.

*Base lands at this resort have been committed to a development pattern. Extensive undeveloped skiing terrain remains which can accommodate thousands more skiers. Base area planning and better space utilization and commitment to long term use is needed to provide parking and other facilities for these people.*

*New communities, such as this, will develop throughout the Rocky Mountain Region as new winter sports resorts are developed.*





## PERMITTEES HAVE A RESPONSIBILITY TO DEVELOP THEIR PRIVATE LANDS TO BE COMPATIBLE WITH PUBLIC LAND MANAGEMENT OBJECTIVES

Public lands may not be developed if the use creates changes which are contrary to the requirements of the National Environmental Policy Act of 1969. Consequently, proponents must plan to develop the private lands to be in character with the National Forest environmental objectives.

## PUBLIC LANDS ARE MADE AVAILABLE TO RESORT DEVELOPERS TO PROVIDE THE GENERAL PUBLIC WITH QUALITY RECREATION OPPORTUNITIES

Private land values near resort areas are largely dependent upon the location of base facilities to ski lifts or scenic terrain. The Forest Service is principally interested in obtaining optimum recreation development to serve the general public.

Providing optimum development of National Forest land must be the first consideration when planning a winter resort area. It should also be an important factor in private land planning. Maximizing the value of individual tracts of private land must be secondary. Development plans for an area must show how skiing terrain will be located in relationship to private lands and the base area. To determine this, approximate locations and general specifications of lifts and runs are needed. The legal commitment of certain private lands between the base areas and National Forest land, for parking, ski runs and hiker access and similar purposes will be needed.

As all seasons resort communities develop near ski areas, the skiing slopes become important hiking and recreation areas. This changing use should be considered when developing an area, since the beauty of the mountain itself during the summer will affect the attractiveness of the area as a resort.

*Desirable skiing terrain has been developed for residential use. This should be done only when the optimum development of the skiing slopes has first been considered.*

*National Forest Boundary* .....

*Existing ski lifts*        - - - - -





## PROVIDING FOR USE OF OTHER GOODS AND SERVICES FROM FOREST LANDS

The timber values on the area may be high enough to warrant commercial sales. The economic and social benefits of placing this material on the market cannot be overlooked. Additional time may be needed in order to provide for sale and removal of merchantable timber. Timber management planning and area development planning should be performed concurrently.

Timber contractors have a responsibility to perform logging operations in a manner which is consistent with the long term use of the land. The necessary practices for the integrated use of the land will be formulated and required in contracts and permits.

Removal of forest products by the ski area permittee, on a break even or loss basis, may be necessary or desirable as an alternative to disposal by burning.

The forest area remaining between ski runs may deteriorate significantly over time, if it is not managed. Exposing trees to wind and sun often accelerates the problem. Perpetuating the viability of the ski resort is the primary consideration. Some young forests might best be thinned in order to maintain strong and full individual trees. Older forests might need treatment in order to allow growth of younger trees.

Transportation planning is an integral part of the planning process. It must reflect the needs of the future for goods and services to come from the area and its surroundings. It must reflect the demands created by a new community. The Forest Service will perform the transportation planning necessary for the multiple use management of the extensive forest areas, which include and surround a ski resort. In some cases, planning for development or management of resources adjacent to a ski resort may not be complete at the time a permittee wishes to develop a ski area. Development of road systems, inside or outside of the permit area, may have to be deferred if a permittee wishes to accelerate his development. In such cases, alternative methods of facility construction may have to be used which do not require roads.

*Maps showing the location of commercial timber on the National Forests are available at Supervisors' Offices. This and other resource data are available in various forms. In some areas, the resource capability of land is being computerized. This will aid planners in making management and development decisions.*



# FOREST TYPE SYMBOLS

## Commercial

- P Ponderosa Pine
- LP Lodgepole Pine
- WLP Whitebark, Limber or Bristlecone Pine
- SF Engelmann, Blue or Black Hills Spruce
- Alpine & Corkbark Fir
- D Douglas Fir
- DS Dead Spruce
- WF White Fir
- A Aspen
- Co Cottonwood
- OH Other Hardwoods

## Non Commercial

- NA Aspen
- NC Chaparral (Oak Brush, Dwarf Trees, etc.)
- NPJ Pinyon, Juniper
- NO Others

## Non Forest

- NF Grass, Rock, Cultivated Land

## Stand Size Class

- 6 Non Stocked or Deforested (burns, clearcuts)
- 7 Seedling, Sapling, 0" to 4.9" d.b.h.
- 8 Pole 5.0" to 10.9" d.b.h.
- 9A Small Sawtimber 11.0" to 20.9" d.b.h.
- 9B Large Sawtimber 21.0" and over d.b.h.

## Crown Density

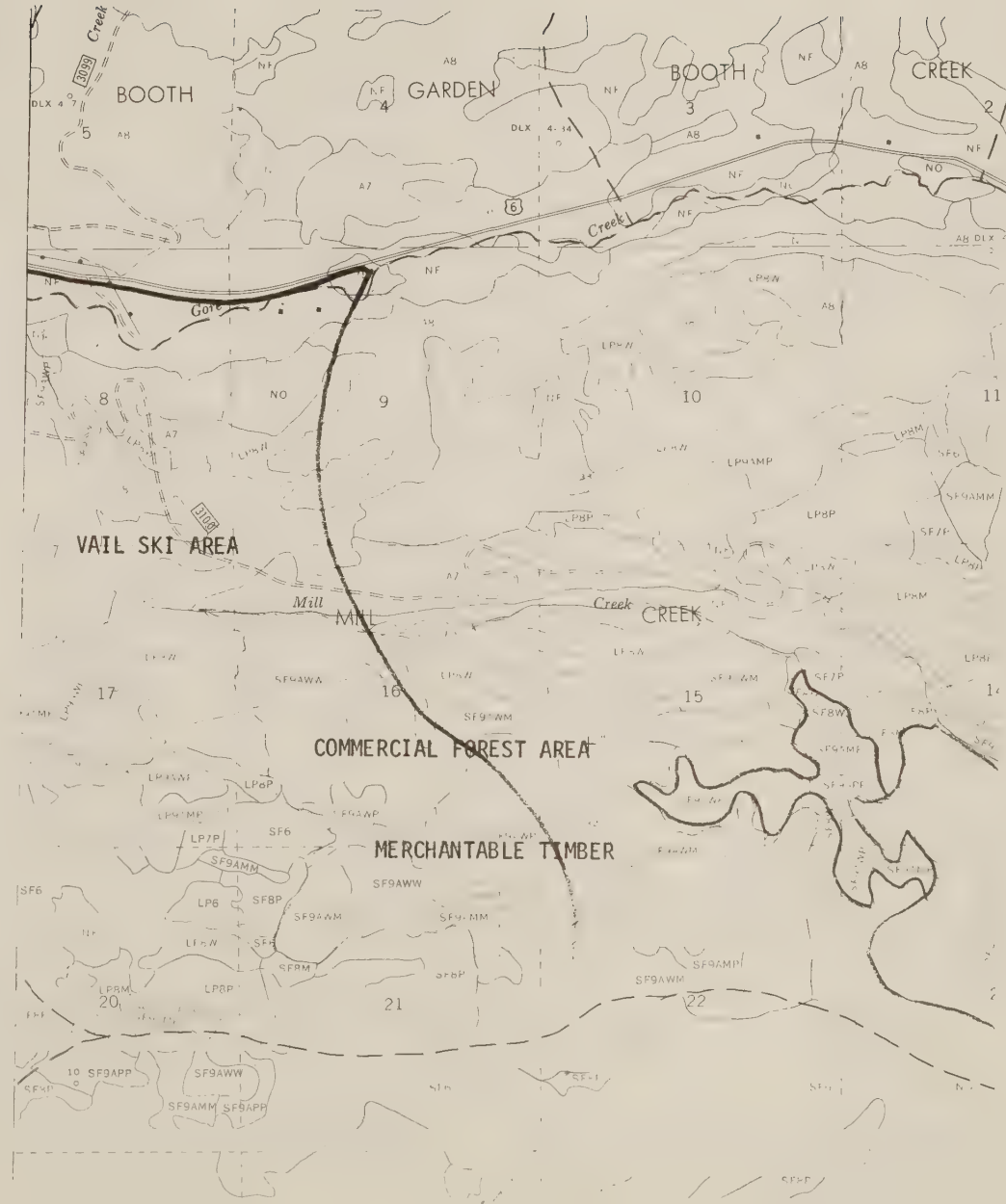
- P Poor 10% to 39%
- M Medium 40% to 69%
- W Well 70% to 100%

Use dual density symbols for sawtimber stand. First symbol refers to stocking on the basis of total crown cover. Second symbol refers to stocking by sawtimber crowns only

## EXAMPLE

SF9AWM Spruce, Small Sawtimber, well stocked on total crown basis, medium stocked on sawtimber crown basis

- Compartment Boundary
- Working Circle Boundary



## UNIT PLANNING

PRIVATE LAND SHOULD NOT BE COMMITTED UNTIL  
SKI LIFT AND TRAIL LOCATIONS HAVE BEEN  
PLANNED. PUBLIC PARKING, LODGES, RESIDENTIAL  
AREAS AND BUSINESSES SHOULD BE LOCATED TO BE  
COMPATIBLE WITH PLANNED LIFTS AND TRAILS.

The general location of skiing runs within a ski area should be determined before any land sale or development begins which could conflict with optimum development of the area. This is particularly important adjacent to proposed base areas. Vehicle, pedestrian and skier traffic flow should be planned to anticipate long range circulation patterns.

Skier access trails across private land must be reserved for future development before subdivisions are platted and roaded. Access roads and adequate parking must be platted and dedicated to that purpose for the full special use permit term. During the conceptual planning process, these general needs should be identified. Before actual lift and trail construction, or private land subdivision, precise location and land commitment must be made.

Trail clearing alters water runoff rates and patterns which might affect private land development. Water drainage changes should be anticipated during planning and provisions made for controlling water from ski runs and through the development areas.

*Private lands were sold adjacent to proposed ski slopes before trail location and design was planned. Proposed new lifts will increase the demands in this area for parking and will add to the congestion where ski trails converge. Snow wear is a major problem because of heavy and concentrated skier traffic. This base area must be designed to accommodate the optimum capacity of skiers which will eventually be served on the slopes.*

*Increased water runoff from cleared slopes has been allowed to flow through private homesites. Flow increases can be predicted and provisions made to control these flows.*

*Gondola lift*

*Chair lifts*      ■      ■      ■      ■      ■      ■      ■

[illegible]



## A MOUNTAIN SHOULD BE DEVELOPED TO PROVIDE QUALITY PUBLIC SKIING

Lifts have been located for reasons other than serving the best skiing terrain or the skier. Ski trails and slopes should be planned to provide the best skiing opportunities without wasting terrain. Lifts should then be located to best serve these ski trails.

Lifts are merely a means of access. The type of lift may vary, depending upon the terrain that it must cross in order to serve the skier and terrain. Seldom should the type of lift dictate the location of ski trails. A lift intended to provide both ski trail access and scenic views for summer tourists is one exception to this principle.

There are various means available for constructing lifts. Lifts should not be located merely because good upper and lower terminal locations have been selected or to minimize construction costs. There are enough lift design alternatives available to accommodate a wide variety of sites. Construction costs should normally be a secondary consideration as compared to skiing quality and to esthetic or other environmental factors.

*Chairlift "B" was located near lift "A" in order to move food and supplies to a hilltop restaurant. This was not efficient and supplies are now moved by an oversnow vehicle. The lift should have been located to serve the best skiing terrain. The alternate location "C" shown could have better utilized the area by serving additional terrain, reducing congestion and providing more variety and vertical drop.*

*The steep trails at the lower right are more difficult to ski than other developed trails served by the same chair lift. It is desirable to separate various ability class trails so skiers are not forced to exceed their ability. The design shown here has also limited the popularity of this lift because of marginal snow conditions at the lower elevations.*

Chairlifts







## A RESORT AREA SHOULD BE PLANNED IRRESPECTIVE OF THE PUBLIC VS. PRIVATE OWNERSHIP PATTERN

All facilities needed to operate a public recreation winter resort area may be located on National Forest land. Private residences and condominiums are two facilities that are not permitted. Public motel or hotel accommodations are allowed and encouraged. Plans and specifications must be reviewed and approved for all facilities installed on National Forest lands. The Forest Service requires that federal, state, local, or commonly used codes or standards be met.

The quality of a public recreation area or resort should not be compromised merely to keep base area facilities on private land. The area should be planned as a unit irrespective of ownership boundaries.

Permit fees for concessionaires using National Forest lands are based upon the total private investment in facilities or improvements necessary for operating an area, whether they are located on private or public lands. As the investment in public service facilities increases, the fee percentage decreases. There are other financial advantages if facilities can be operated in the most efficient manner possible.

*Flat valley bottom and agricultural lands are typically in private ownership in the Rocky Mountain Region.*







## SKIING QUALITY CAN BE IMPROVED IF CONGESTION IS AVOIDED

Two types of ski slope design are evident at the Buttermilk Ski Area. Skiers using the slopes at the right can ski without interference by skiers coming from either side. If a mountain is designed permitting inter-connecting, but separate ski run systems, a skier can have the feeling of isolation and freedom from congestion. Open slopes are also desirable if they do not create congestion or over-use of critical areas.

Very often, skiers on open slopes tend to heavily use certain portions and avoid others. It is not necessarily because of better ski terrain.

When designing a system of lifts and trails, the ultimate development should be planned in order that future lifts and additional trails will not create conflict, congestion, crowding or worn out snow conditions.

Notice that a single, permanent road system has been developed and located where impairment of skiing quality has been minimized.

*Unneeded construction roads have been regraded to the original contour. New technology is permitting lifts to be constructed without the need for the time consuming road construction, extra expense and possible damage to skiing quality.*

*Using clockwise, or counter-clockwise lift patterns can direct skiers into preferred trail systems, thus improving trail utilization and avoiding congestion.*

Existing chair lifts ■■■■■■



## CONCEPTUAL PLANNING MUST PRECEDE DETAILED FACILITY SURVEYS AND CONSTRUCTION

Ideas that appear valid during initial planning are often found to be shortsighted as planning progresses and future development is considered. Lift lines, ski runs, survey lines and other clearings have been made which have never been used. These create an unnecessary and unnatural impact on the landscape. They are also expensive.

During the planning period, only minimal manipulation of the terrain and vegetative cover will be permitted. This will maintain the area's natural character until plans and development schedules are finalized.

Extensive field study and data analysis are necessary before specific recommendations can be made. Proponents have this responsibility. The Forest Service has the responsibility to objectively critique and evaluate proposals in cooperation with the proponent.

*The ski lift clearing in the center was never used. A chairlift crosses this line in order to serve the terrain at the right. This impact could have been avoided.*

*The chairlift illustrated moves skiers uphill from both the left and right of the picture. They are unloaded near the cleared lift line in the center.*

*As additional ski terrain is developed at the far right, new means must be devised to return skiers to the base area at the left.*

Existing chairlift    

Proposed chairlift    









BASE 2

# BASE 1



## BALANCING LIFT LOCATION AND CAPACITY TO PROVIDE EFFICIENT DISTRIBUTION OF SKIERS THROUGHOUT THE LIFT SYSTEM AND AREA

When the majority of the ski lift capacity is far removed from the base area, it is important that the lifts be located and have sufficient capacity to: (1) provide for efficient distribution of skiers throughout the lift system and area in a reasonable amount of time and, (2) provide ski lift capacity for skiers not wishing to use lifts far removed from the base area.

A variety of factors should be considered. Some of the more important ones include:

- a. Vertical feet of skiing per day by average skier ranges from 8,000 to 11,000.
- b. The out-of-base lift capacity as a percent of the overall mountain lift capacity.
- c. Lifts that do not provide access to remote lifts are not counted, except as they serve skiers wishing to remain adjacent to the base area.
- d. Working efficiency of the lifts, as compared to maximum design capacity.
- e. Opening time of lifts, as it relates to moving skiers to slopes by mid-morning.
- f. Providing for skier return early and late in season when lower slopes may be short of snow. Lower than average number of skiers during this period may offset this problem.
- g. Wearing out snow at base area if concentration of skiers is too great.


*Lift System "A" is in balance, providing sufficient capacity out of the base to serve the more remote lifts and to permit a reasonably long day use at full capacity of these remote lifts.*

*Lift System "B" provides recirculating skiing for those not wishing to leave the base area until the out-of-base lift system has moved skiers from the base to the remote lifts.*

*Lift System "C" would provide extra lift capacity in the remote areas, but would reduce the overall efficiency of the remote lift system until additional access could be provided out of the base area.*

*Without a new base area, the remaining suitable, but undeveloped remote skiing terrain, could not be utilized efficiently. If too much capacity was developed out of the original base area, these access lifts would not be fully utilized after skiers were moved to the remote areas. Snow wear might become excessive at the relatively constricted return route (X) at the base.*

Lift System "A" 

Lift System "B" 

Lift System "C" 



## “CRITICAL POINTS” SHOULD BE IDENTIFIED AND THE ALTERNATIVES PLANNED

Good long range plans are flexible enough to permit changes which could not be anticipated initially. However, it is often necessary to intensively plan certain "Critical Points" to ensure that a variety of options can be followed in the future. Expensive facilities have often been installed and later modified or removed in order to allow for the orderly and proper expansion of the area.

These critical situations take many forms—base areas, key skier circulation areas, avalanche paths, unstable soils, skier concentration and service areas, etc. Since very large capital expenditures must be made at centralized service centers served by several lifts, it is important that the proper site be selected from several possible alternatives. Unless the long term possibilities are recognized initially, the results could be physically irreversible or prohibitively expensive.

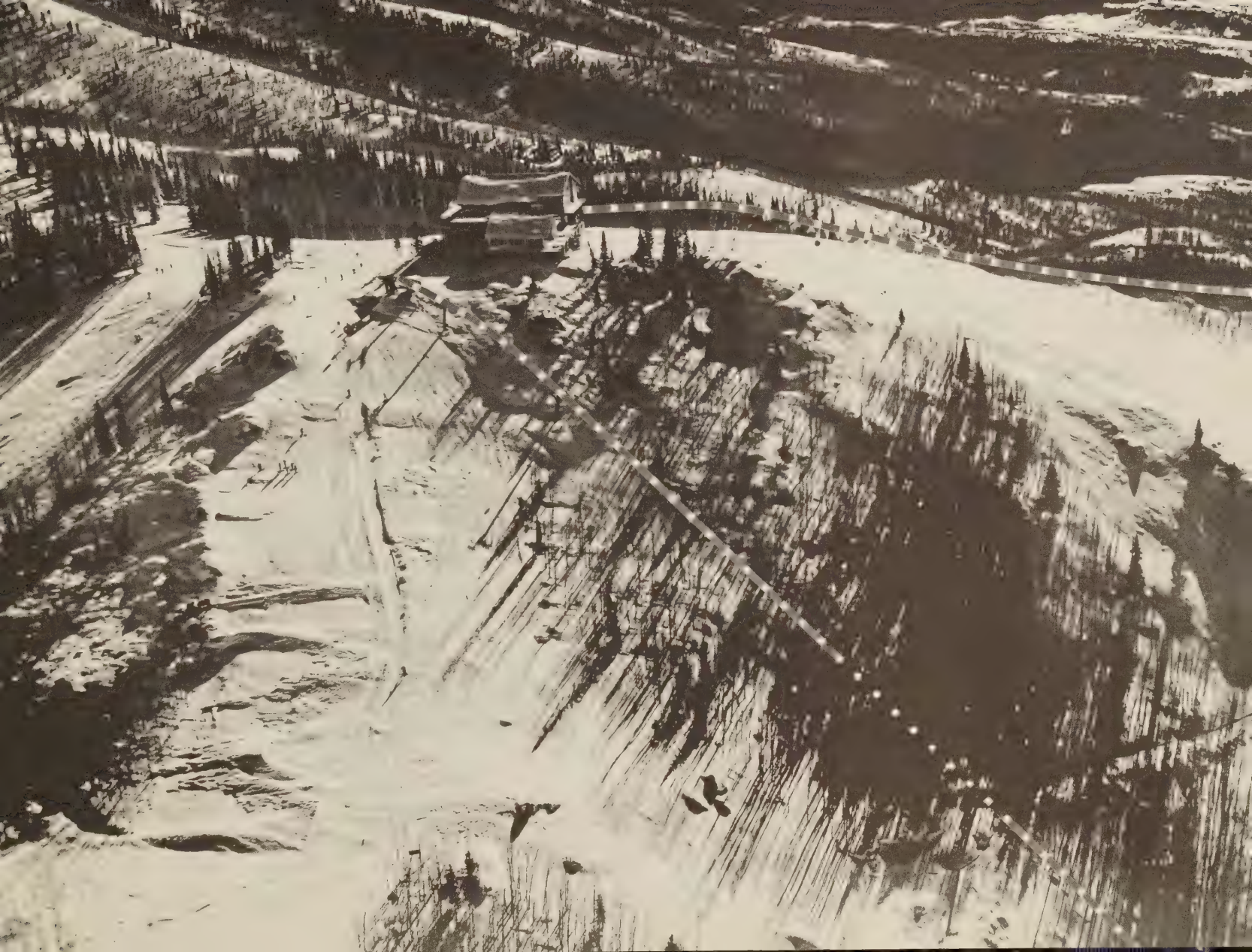
Key service and distribution centers located high on the mountain have been developed at major resort sites. Because development plan changes were later recognized, some resort areas are now facing these problems.

*The hill top is critical to skier access and distribution at a very large and expanding area. Factors which must be considered when planning sites like this include:*

- a. Space for top terminals of all anticipated lifts and room for skier unloading.
- b. Location of water storage tank and pipe lines which will not conflict with other facilities.
- c. Restaurant facilities and space for the largest development anticipated.
- d. Location of electrical terminals and distribution lines for all planned facilities.
- e. Space for sewage disposal system.
- f. Effect wind might have on the site after timber has been cleared and facilities installed. Snow could blow away. Wind could cause slowdown or stoppage of lifts critical to movement and dispersal of skiers. Comfort and safety of people.
- g. Movement of skiers away from lift unloading areas and toward restaurant or ski runs.
- h. Esthetics of the site after development is complete.
- i. Ability of the soil to accommodate the extensive and expensive development.
- j. Ski racks and other space using items.

Main area access lifts ■■■■■■





## UTILITY SYSTEMS

### Domestic Water

New resort communities must anticipate their water needs. Plans must provide for this impact which the resort itself has created. Maintenance of water quality is not only important to the new community, but to the downstream user as well. Because of prior claims, sufficient water rights may not be available for new resort or community development. Sufficient rights must be acquired not only for the domestic use, but for any snowmaking needs as well.

### Sewage Treatment

Treatment of sewage receives close scrutiny from the Forest Service and other agencies. Before construction of treatment facilities is authorized, plans must be reviewed and approved by agencies such as the Federal Water Quality Administration, the State and County Health Departments and the Forest Service. This may be a time consuming process, but is one which cannot be short cut at the expense of public health. Many of the areas suitable for future development of winter resort areas lie high in the headwaters of domestic watersheds. For example, waste water flowing into Dillon Reservoir, a water storage area for Denver, must receive tertiary treatment before being released.

### Power Transmission and Telephones

Power lines and telephone cables which are visible from the base or lift served areas must be underground. Consequently, a thorough knowledge of future lift and run locations is needed before any proposals are made to install power lines to lifts and buildings. It will be most efficient if the approximate location of all distribution line needs can be determined during the planning stage.

It may take years of lead time for utility companies to provide new transmission line service to an area. Basic needs should be estimated many years in advance.

## MANAGEMENT OF VISUAL CONSIDERATIONS

Skiing is but one of many recreation uses of the National Forests. Although it is one of the fastest growing sports in the nation, it represents a very small percent of the recreation use. The public has become more aware of and concerned about the environment and the developments in and adjacent to the public lands.

Many of the potential winter resort areas are readily visible from major highways and from other heavily used recreation areas. The amount of landscape modification permitted will vary greatly with slope, aspect, vegetation color, texture and type of terrain and distance from the viewer.

Appearances must be considered in these developments. A variety of methods to lessen impacts should be considered by the planner. Runs can be shaped and natural openings used to minimize straight line effect. Feathering and scalloping of trail edges, thinning or glading of timber, creating natural appearing openings, and other methods are effective. Lift lines can be blended into ski runs, topography and natural openings. Roads can be minimized, eliminated, or designed and screened in a manner that will not detract from the esthetics.

Areas of high and low visual impact can be mapped, using contour maps and sight lines from key viewing areas. Photographs from the air and from viewing areas can be used to identify situations and relate them accurately to locations on the ground.

Copper Mountain, adjacent to Interstate 70 Highway, will be viewed by thousands of travelers each year who are driving through the Rocky Mountains primarily to enjoy the mountain scenery. While a completely natural appearance is not possible, a great deal can be done to minimize the impacts.

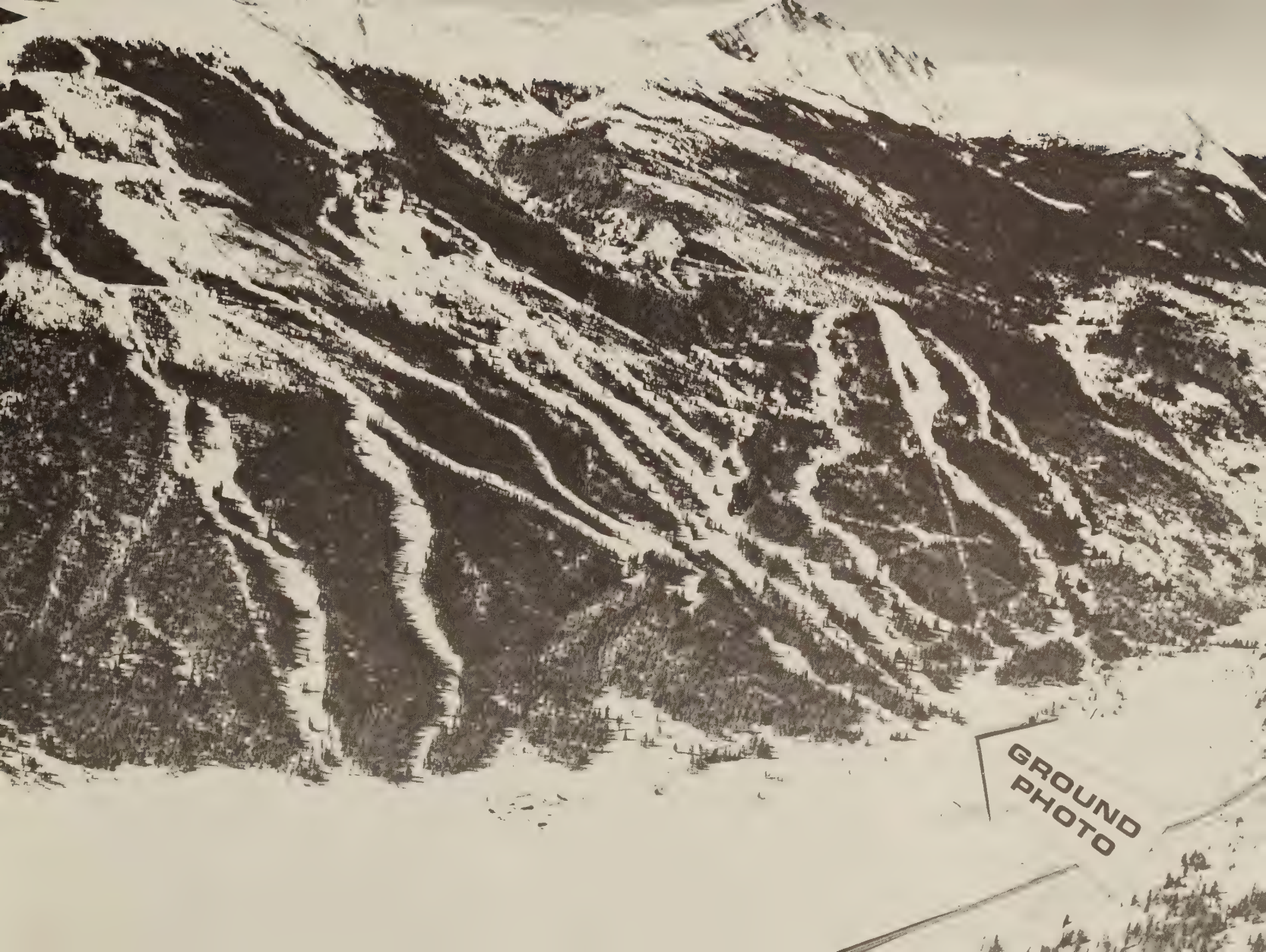
The extra effort may not be more expensive than practices followed in the past. Many relatively unpopular ski runs have been cleared at great expense. Even large portions of many popular trails receive little or only moderate use. Thorough planning of road and trail systems and base areas can produce both good skiing and an esthetically pleasing appearance. Development of both the public and private lands for winter resorts must protect the character and charm of this magnificent scenery.

*The following two pages show Copper Mountain, as seen from Interstate 70, after ski runs have been cleared, and also as seen from the air.*









GROUND  
PHOTO

## EFFECTS OF WIND AND SUN

The problems of developing ski areas above timberline in the Rocky Mountains are fairly well known. The chilling wind can be very uncomfortable and dangerous to the skier. Snow is easily blown away, exposing rocks. Lifts in these exposed areas have not generally operated efficiently. "Down time" has been much greater when compared to lifts located in protected areas. Avalanche hazards tend to be more prevalent and more difficult to control. Development in such locations will normally be allowed only to augment more protected systems and then only after extensive studies have been made.

There are many examples where clearing of trees below timberline exposed the ground and snow to winds, making runs unusable for all or significant parts of the skiing season. Usually, these clearings have been authorized because the proponent insisted that he had made adequate, but improperly documented, wind and snow studies.

Alignment of ski trails in relation to wind direction is a key factor. Thorough knowledge of wind direction and speed and its effect is a prerequisite to ski run clearing. One effective planning practice has been to locate wind instruments above the trees for extended periods of time and to move them throughout the planning area, recording the presence or absence of wind in the process. In some cases, limited clearing has been authorized in order to verify snow deposition and wind conditions. Research data are available which show the effects of wind on snow deposition and scour, under a variety of run or clearing conditions.

Where wind is known to cause scouring problems, studies and tests should be conducted to determine if snow can effectively be drifted onto proposed runs and held there. There are many applications of this technique in this region.

Clearing should be done gradually, preferably beginning at least one year before lifts are to be installed. As more knowledge is gained about an area, this becomes less important. It is easier to cut additional trees than to install snow fences and attempt to regrow trees. The presence or lack of wind effect on living trees can be a clue of wind situations.

The sun's effect can have devastating consequences on snow depending upon the season, slope, aspect, vegetative cover and height of cover adjacent to planned runs. Where wind or sun are limiting factors in development or operation, affected areas should be mapped and thoroughly studied.

*The area shown here had adequate snow depth before the timber was cleared. The new chairlift did not operate the first two winters after it was installed.*





**SNOW FENCE**

**SCOUR**

## SKIER SAFETY AND AVALANCHE CONTROL

The seriousness of avalanche hazards at ski areas and the costs of effective snow safety programs are continually underestimated by area planners and developers. Perhaps it is a misunderstanding of the problem. Consequently, very many large and modern ski areas in the United States face continuing problems and annual expenses which far exceed the amount the area's planners originally spent to evaluate the situation.

Typical problems include:

Small inconspicuous slide paths are a major hazard. The large paths are usually well identified.

Skiers looking for powder snow in the trees adjacent to cleared slopes often are unaware of hazards.

Roads, parking lots, buildings, lift terminals and towers are still proposed in slide paths. Planners spend insufficient time in the field immediately after storms, or during hazard conditions, to recognize these hazards. Identifying them during the summer is often difficult. Historical data should be obtained.

Ski area operations are often complicated or disrupted by avalanche problems.

In complex situations, a large number of snow safety technicians are needed to ensure public safety. Area layout should be such that segments of the area can always be operated while control is being carried out in the more hazardous areas.

The need for artillery or recoilless rifle control measures should be avoided. This equipment may not be available indefinitely. Ammunition and control crews will become a greater expense to permittees. An area should be planned so control teams can get above the hazards using ski lifts. Teams should be able to ski down to control areas and control by protective skiing or use of hand charges.

Caring for avalanche weather forecasting instruments and collecting and analyzing data is time consuming, expensive and essential at high hazard areas. Permittees are expected to own, operate and use this forecasting equipment.

Where avalanche hazards exist, preliminary safety and operating plans, along with cost analyses, should be part of the development plan.

*Chairlifts*

Surface lift—Access to avalanche control areas ■■■■■■■■■■





SLIDE AREA



## SKI RUN CLEARING AND CONSTRUCTION

When large areas are cleared, the effects can be severe. The snowpack character changes on ski runs and the amount and rate of the spring runoff is also altered. Percolation of snowmelt into the soil is reduced, further aggravating the runoff situation. The runoff must be controlled in order to prevent soil loss and impairment of water quality. Planning is required in order to stabilize the soil between the time of clearing and the fall. Water runoff in the spring must be anticipated and provisions made to control or regulate it.

Both soil and hydrology studies are necessary as a basis for land clearing and slope grading proposals. Planners should know precisely what areas will require machine shaping. Plans should show how the ground will be reshaped and how the cut and fill sections will be stabilized. The effect of clearing or soil moisture content should be anticipated and adverse effects controlled. Bulldozing will not be allowed simply to minimize clearing or slope maintenance costs. Shaping may be allowed when a plan shows how it will be done and how the land will be stabilized. There may be other reasons than stabilizing soil for prohibiting slope shaping. Esthetics is one example. The Forest Service recognizes the need for well groomed ski slopes. Therefore, complete proposals should be submitted for the entire clearing operation, as part of the development plan.

Fertility and depth of soil varies widely throughout the Rocky Mountain Region. Practices that may be allowed in one area, on a given type of soil, may not be acceptable elsewhere. Surface erosion, which is the main concern in a given area, requires a different treatment and prescription than an area where the entire landmass is unstable. Landslides are a common occurrence at some areas when soil becomes saturated.

*The large landslide at the upper left occurred many decades ago. It indicates mass soil instability.*

*Slopes below timberline can usually be revegetated. When disturbed, the thin soils above timberline are restored only at great expense.*



## SOIL PROTECTION AND TREATMENT

Before a site is approved for resort development, a preliminary soils report must be prepared as part of the environmental analysis. It is through this analysis that the basic land use decisions are made. The preliminary soils report is general in nature and estimates the suitability, hazards and limitations of the area for various impacts.

A more comprehensive soil report is prepared during the conceptual development planning process, after a site has been designated for development. This identifies where problems exist. It is based upon soil inventories and examinations of the upper five feet of the earth's crust. Where deep soil situations are significant, or mass land instability is involved, the services of engineering geologists become involved.

Soil inventories include soil maps, technical descriptions and interpretations. The soil maps show the extent and distribution of the different soils of the area. Soil descriptions are the recorded information of the physical and chemical soil characteristics of each soil body. Soil interpretations are derived from soil characteristics and the environmental influence of climate, geology, topography and vegetation.

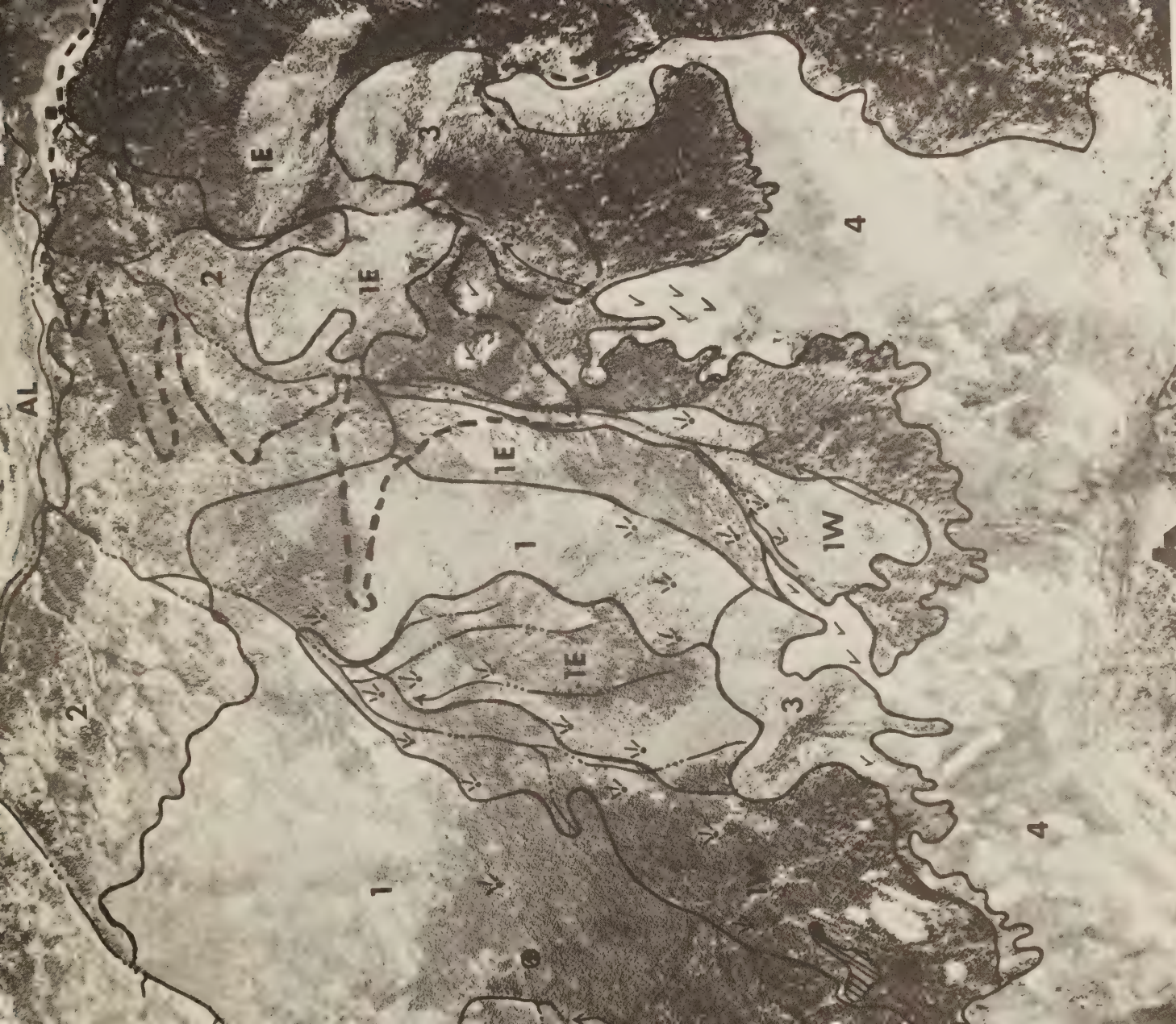
The soil inventory includes the following interpretations:

1. Mass movement potential of the surface and underlying soils.
2. Erosion potential of surface soils if protective cover is disturbed.
3. Limitations for maintaining and reestablishing vegetation.
4. Soil drainage characteristics.
5. Soil limitations for road location and construction.
6. Soil limitations for sewage disposal.
7. Soil limitations for low building foundations.
8. Soil limitations for ski runs.




Soil inventories furnish part of the basic data necessary to determine where ski runs, roads, lifts, buildings, buried utility lines, sewage treatment plants and other facilities can be constructed with a minimum of damage to the environment.




*Preliminary soils report map for Copper Mountain Ski Area. This identifies suitability for ski area development, hazards to be expected with various land practices, and limitations affecting development.*





# LEGEND

wet spot   
 rock-outcrop   
 stream 

lake   
 building   
 road 

Scale: 1: 20,000

## SOIL ENGINEERING AND STUDIES REQUIRED FOR CONSTRUCTION PLANS

When the most appropriate alternatives have been selected for installing facilities and locating ski runs, roads and other improvements, a detailed site analysis of the soils, relative to design, will usually be necessary. These studies provide detail information for a specific section of the construction site. These problem areas, which are unavoidable in planning, need specific information for design to overcome limitations or hazards. The expertise of hydrologists, geologists and engineers are needed to design systems for fragile soils and hazardous sites. Deep borings, laboratory tests and detail studies are often necessary. Specific prescriptions may also be necessary to ensure revegetation and stabilization of the site in order to prevent erosion or other soil problems during the winter or spring.

*A variety of situations are shown here which should have been studied in greater detail before construction began.*

*Effect of earth fill on water courses.*

*Land slide activity.*

*Ability of steep soils to withstand spring snow melt without eroding (hill in background).*

*Stabilizing construction roads.*

*Reestablishing vegetation.*







## VERTICAL AND OBLIQUE AERIAL PHOTOGRAPHY CAN BE USED TO IDENTIFY A WIDE VARIETY OF RESOURCE SITUATIONS

Interpretation of color and black-white stereopair vertical photographs, or oblique photographs can identify mass land instability, vegetative cover type, drainage patterns, rock outcroppings, topography and other features. Vertical photographs of the national forests are available for inspection at forest offices or can be purchased for a nominal cost. They are invaluable for the planning process. For very detailed surveys, or for preparation of contour maps necessary for adequate area planning, new photography and ground control may be necessary. For best results, photographs should be taken during the summer when the sun angle is high. This will permit maximum interpretive detail, particularly in steep terrain or timbered areas. There is not a significant difference in cost between color and black-white photography for areas the size of a ski resort. With a minimum amount of training, ski area managers and planners can learn to use photographs effectively. Complex interpretation may require specialists.

Oblique photos, such as this are easily obtained with 35mm hand cameras from light reconnaissance aircraft. Although control needed for precise measurements is not possible, topographic features are easily identifiable. The locations of lifts, ski runs, soil types, vegetative types, avalanche hazard areas, features involving safety or operating procedures, etc. can easily be noted for planning or field identification.

*The runs at the left were developed without the benefit of detailed mass land stability analysis. As part of the long range development plan, the area at the right was proposed for possible development. Planners were not aware of the massive and fairly recent landslide in that area. Presence of the slide would not necessarily preclude ski lift or run development. The means necessary to prevent reactivation of the slide would need to be determined. Preventing soil saturation and avoiding excavation at critical points might be the only special precautions needed.*

Existing chairlift

*Proposed chairlift*









## AIR QUALITY STANDARDS MUST BE MAINTAINED

The concern for the environment has led to legislation, such as in the State of Colorado where procedures were established governing the burning of wood product waste and other materials. The Forest Service will be reviewing permittees' proposals for wood slash disposal. Alternatives to burning must be investigated, and used where advisable, before burning will be recommended.

There are various alternative means of disposing of wood debris:

Commercial timber sales of merchantable logs.

Burying of stumps and debris where good compaction can be obtained and where watershed values will not be damaged. Soil stability of fills must be provided. Material shall not be buried where flowing water can flow through uncompacted fill material. The surface of disturbed areas must be stabilized.

Medium size and smaller material can be chipped. Chips can normally be scattered into the timber, spread on the trails, or disposed of in other ways, as appropriate.

Material can be cut and disposed of as firewood.

Burning can be authorized after other methods have been used or are inappropriate. Burning should be done during periods when smoke will be rapidly dispersed into the atmosphere. Special fans and pits can be used to force hotter burning, thus minimizing the amount of smoke dispersed into the air. Burning can be performed during periods of low or moderate fire danger. The permittee will be required to provide adequate fire fighting equipment and manpower to ensure safe burning practices.

If the ski industry cannot meet the stringent air quality requirements, and does not demonstrate a sincere effort to minimize air pollution, more restrictive requirements may be imposed.

*The smoke is dispersing well into the atmosphere because of instability between the heated air and the atmosphere. Notice how the stable clouds blanket the mountains in the background. Smoke will react in a similar manner during stable air conditions.*





**INNOVATIVE CONSTRUCTION METHODS SHOULD BE  
USED IN ORDER TO PROTECT THE ENVIRONMENT,  
SHORTEN THE TIME NEEDED FOR CONSTRUCTION,  
REDUCE COSTS AND INCREASE REVENUES**

The presence of road cuts across ski runs not only downgrades skiing quality, but may shorten the effective season if heavy snowfall is needed to cover roads. Cuts and fills also make snowpacking difficult. Roads may become a continuing maintenance problem and are often costly to construct. They may cause untenable esthetic damage, particularly if located, designed or constructed improperly. Esthetic or soil considerations may preclude them entirely.

The length of the construction season is critical to any ski area construction program. If roads must be constructed to lift tower sites, a large portion of the construction season may pass before actual lift construction can begin. Lift construction often extends late into the fall or early winter.

Area operators in the Rocky Mountain and other Regions have found that chairlift tower installations by helicopter saves them time and money. Some ski area operators have been pumping concrete to tower sites without roads, at a considerable saving over moving concrete exclusively with helicopters.

The developer also plans to convert trees from ski runs to usable building materials, as an alternative to disposal by other more costly means. Here is a case where ingenuity has been used to overcome environmental constraints and building problems. Large construction helicopters and other innovative forms of construction equipment are available to ski area developers and should be used. Portable cable logging systems, as well as rubber tired log skidding machines, are also available for clearing of ski runs.

*This helicopter is lifting complete chairlift tower assemblies to elevations over 11,000 feet at the Keystone Ski Area, near the Continental Divide, in Colorado.*



## WHAT ROADS ARE NEEDED TO SERVE A SKI AREA

A well planned road system is usually needed to ensure an efficient operation. However, unneeded roads may be a liability. Unneeded construction roads to tower locations can be backfilled and revegetated after they have fulfilled their purpose. However, serious consideration should be given to alternate methods of construction if roads need to be constructed that have no after use.

The main road system should be located so it will not interfere with the long term operation of the area. Roads should be located, designed and constructed to serve the purpose for which they are needed and for their long term maintenance. Roads can be narrow where they cross ski runs. Culverts can direct water away from ski runs and help control the water runoff problems. Switchbacks can be located on flat benches where they won't damage skiing quality, or can be confined to areas where no ski runs will ever be needed.

Certain roads may be needed to provide for future area construction or to move supplies and personnel during the winter. The long range location and use should be determined for the overall development, before construction begins.

*Much of the prime skiing terrain has been compromised by the road location illustrated here.*

*Several chairlifts have been constructed using the road above the building shown at the lower left. A road could have been located which would have served this area with minimum effect on skiing quality.*

*Chairlifts* 

Surface lift





## ROADS AND DEVELOPMENT COSTS VS. SKIING

Snowpacking equipment cannot easily care for trails having abrupt road crossings, nor can skiers cross them easily or safely. Trails of intermediate difficulty become more difficult to ski if they are crossed with roads at steep locations.

Snowpacking machines should not cross ski trails at steep locations as they work their way up the hill. These routes become flat "benches" and downgrade skiing quality.

Skiing quality sells an area and the need for well groomed slopes is well recognized.

Ski runs should be designed so snow maintenance equipment can operate efficiently.







Detailed information regarding development of resorts and ski areas at a specific location can be obtained from the Forest Supervisors listed below. General information is available from the Regional Forester, Building 85, Denver Federal Center, Denver, Colorado 80225.

Arapaho	1010 Tenth Street, Golden, Colorado	80401
Bighorn	Columbus Building, Sheridan, Wyoming	82801
Black Hills	Forest Service Office Building, Custer, South Dakota	57730
Grand Mesa-Uncompahgre	11th and Main Street, Delta, Colorado	81416
Gunnison	216 North Colorado, Gunnison, Colorado	81230
Medicine Bow	605 Skyline Drive, Laramie, Wyoming	82070
Nebraska	270 Pine Street, Chadron, Nebraska	69337
Pike	320 West Fillmore, Colorado Springs, Colorado	80907
Rio Grande	Route 3, Monte Vista, Colorado	81144
Roosevelt	211 Canyon, Fort Collins, Colorado	80521
Routt	Hunt Building, Steamboat Springs, Colorado	80477
San Isabel	910 Highway 50 West, Pueblo, Colorado	81003
San Juan	Oliger Building, Durango, Colorado	81301
Shoshone	1731 Sheridan Avenue, Cody, Wyoming	82414
White River	Old Federal Building, Glenwood Springs, Colorado	81601

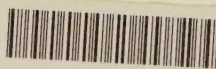












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